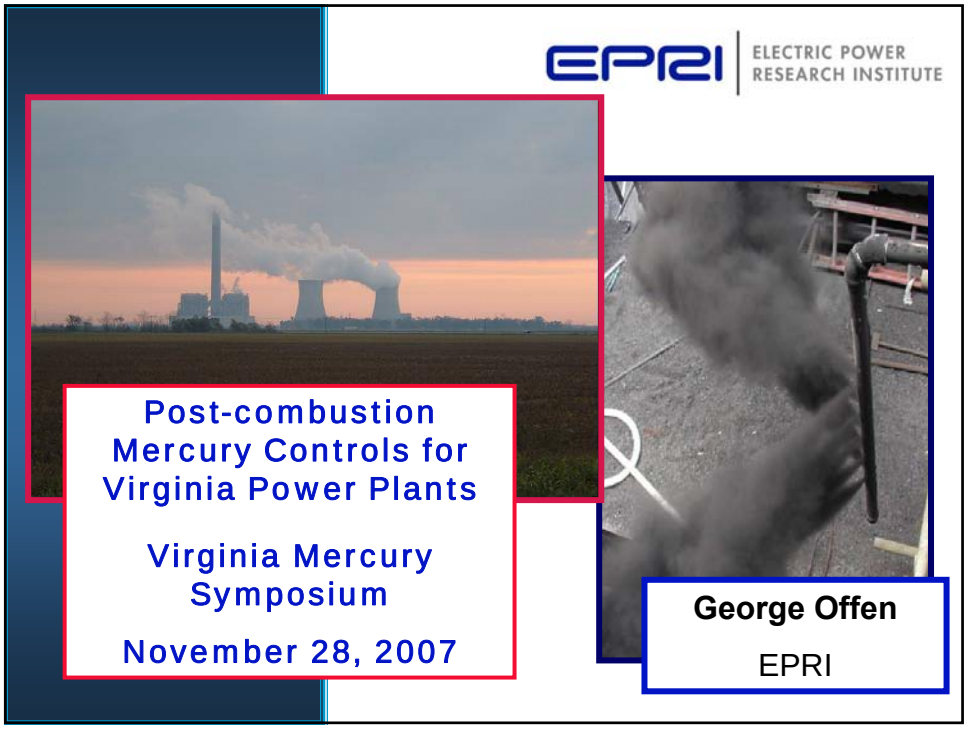
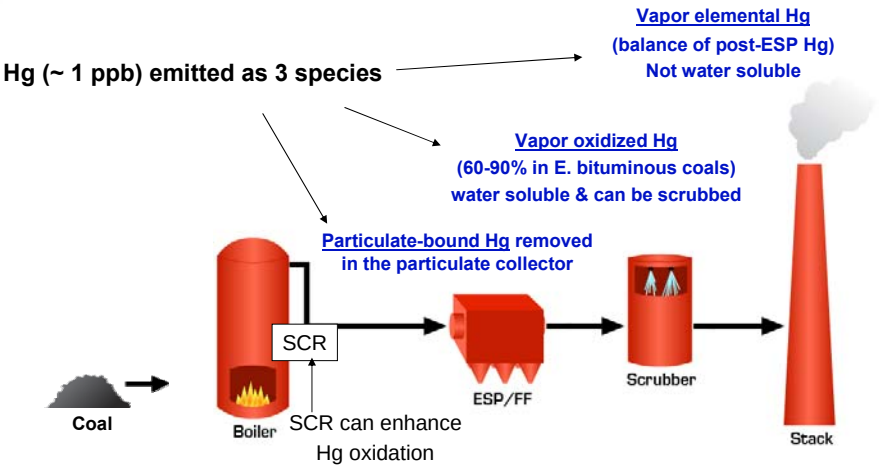


Power Plant Mercury (Hg) Emissions and Control: The Basics



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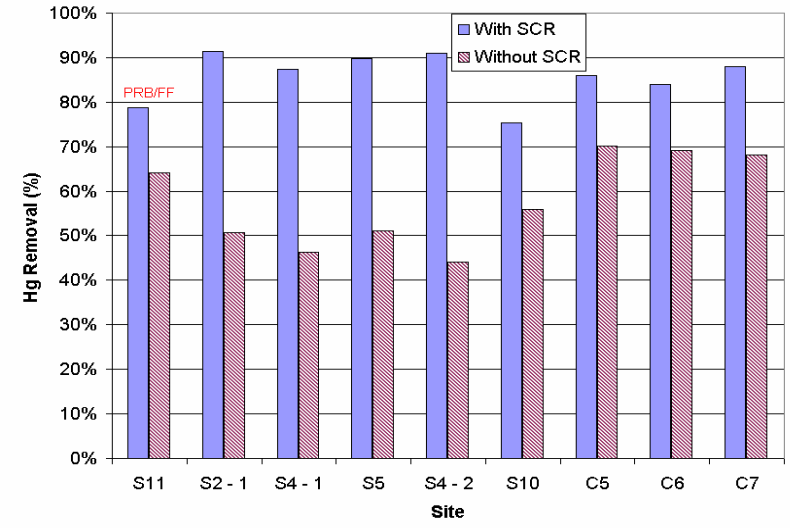
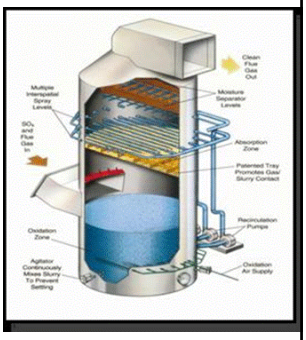
Co-benefits Offer Substantial Hg Reductions, but Concerns Remain



Co-benefits – What Do We/Don't We Know?

- FGD captures most oxidized mercury (Hg^{2+})
- Capture rates high, but 90% ΔHg not routinely achieved
  - 3 of 18 measurements >90%
  - One site as example
    - 95% Hg^{2+} at FGD inlet
    - 96% Hg^{2+} "removal"

    Ideally ➔ 91.2% Hg removal, but
    - 0.4 μg/m³ re-emissions ➔ 86% removal
- Research plans
  - Continue fundamental chemistry work
    - Why re-emissions? How stop?
    - How direct Hg to desired discharge stream?
  - Seek patterns from data for SCR/FGD sites with <90% removal
  - Evaluate options to enhance removal



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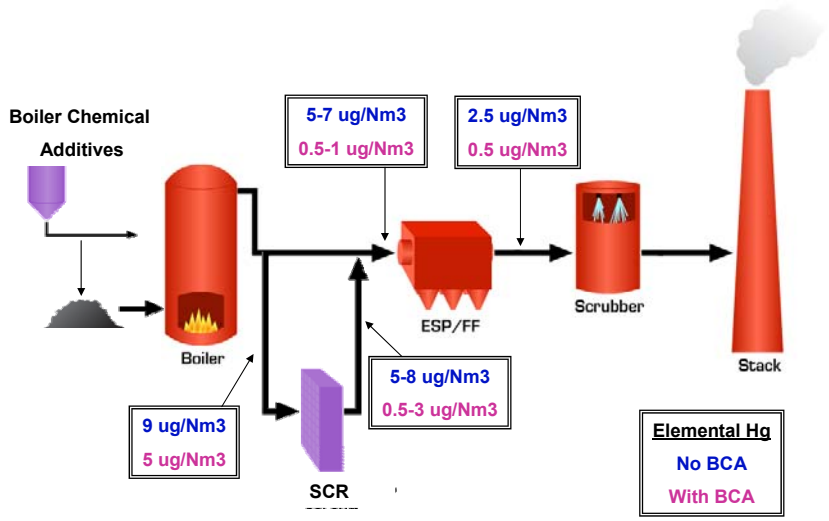
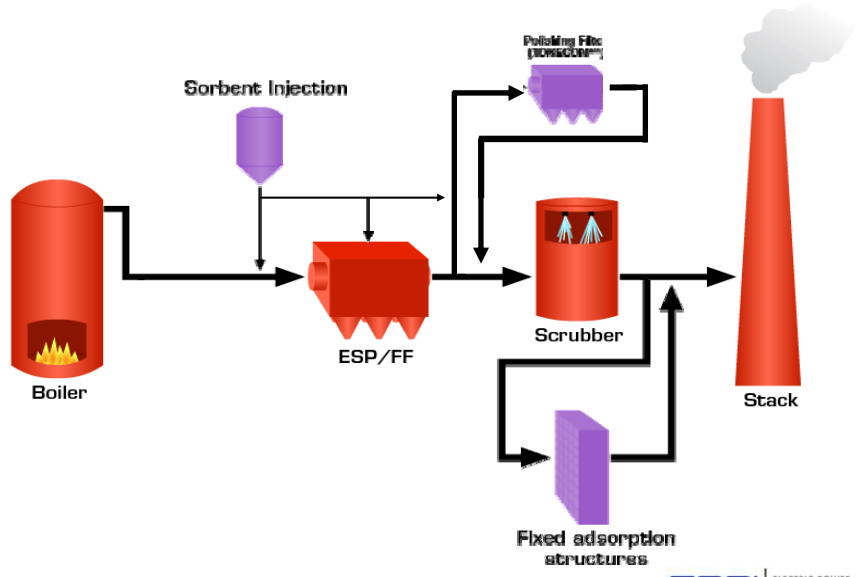
One Potential Solution – Boiler Chemical Additives (BCA) to Promote Hg Oxidation



Re-emission Inhibitors for Enhanced Mercury Control

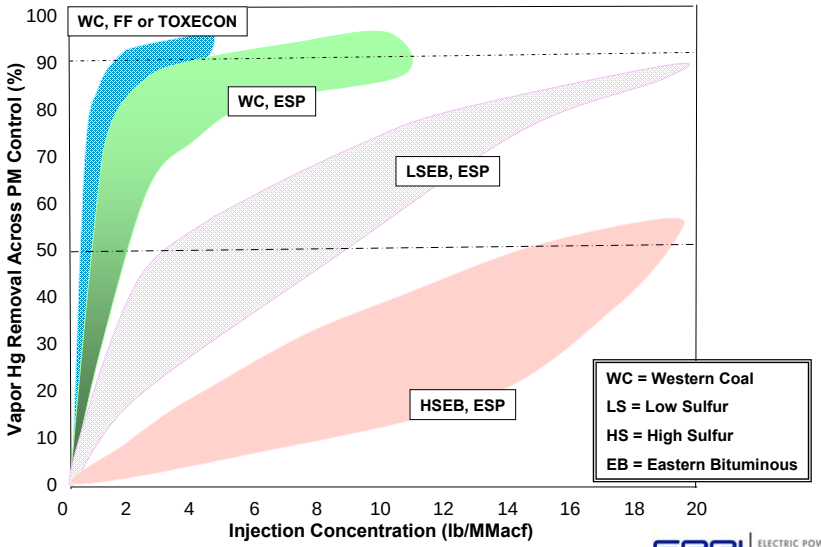
- 2004 options = B&W's NaHS and DeGussa's TMT-15
- B&W additive tested by DOE-NETL ➔ mixed results, so EPRI investigated TMT-15
- Pilot-scale inconclusive, full-scale (2 sites) not effective, complex behavior
  - Periods of low and periods of high re-emissions
  - Complex behavior with Ca, Mg in FGD liquid
- Now testing other additives – e.g., Nalco, PRAVO, other
- Expect related chemistry for (a) re-emissions and (b) Hg partitioning to liquid vs solid discharge streams

Mercury Controls for Unscrubbed Units – Sorbent Injection & Related Adsorption Processes

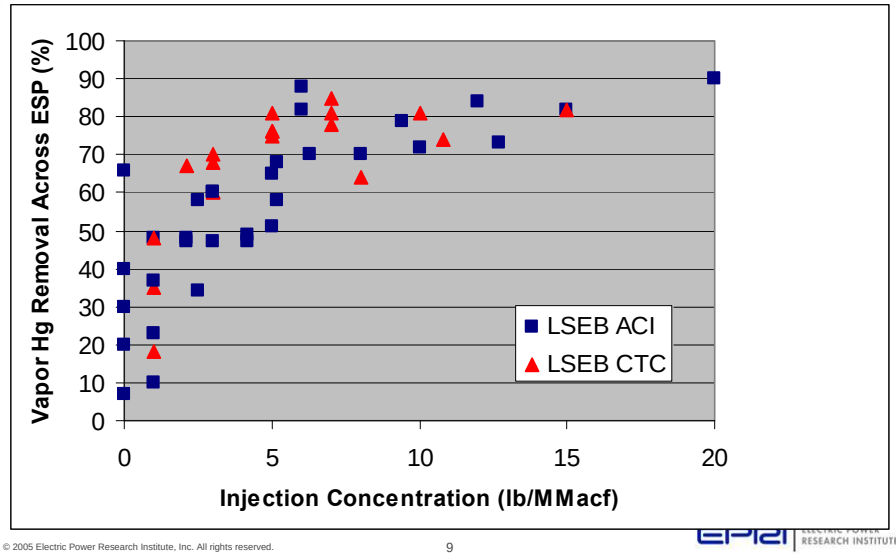


Activated Carbon Injection Hg Removal Effectiveness Highly Dependent on Coal, Particulate Control

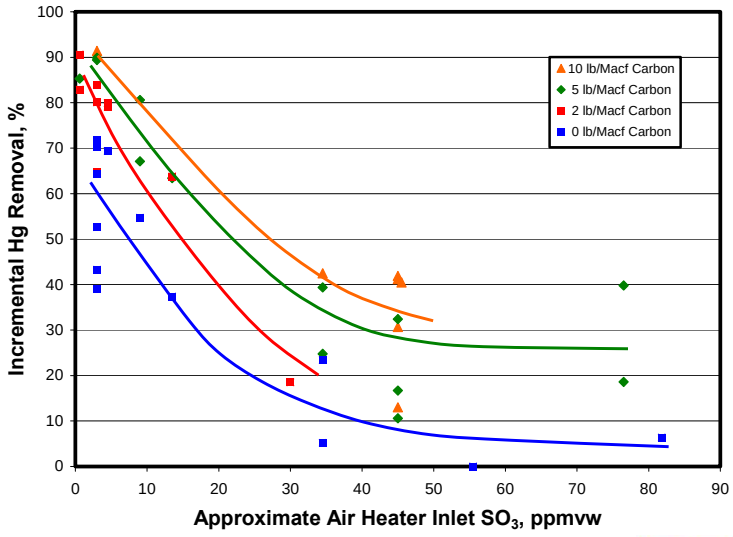
(Most data from tests <1 month)



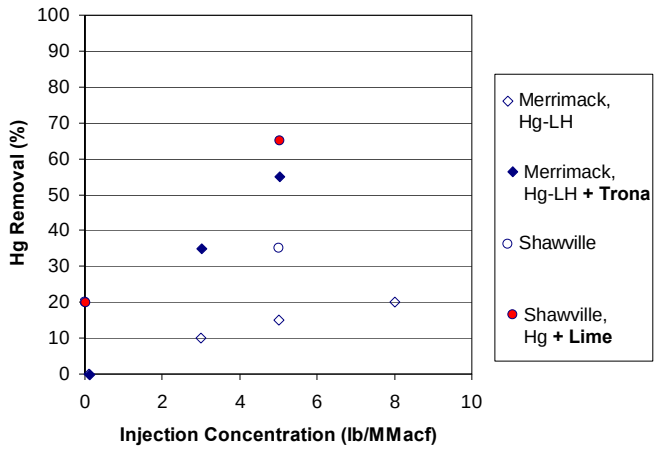
Example of Challenges – Performance Variations in ΔHg Across ESP (LSEB)



SO_3 Reduces Hg Removal Across ESP
(5 MW pilot, high LOI)



Co-Injection with Alkaline Sorbents – One Approach to Reduce Impact of SO_3



Slide courtesy of ADAES

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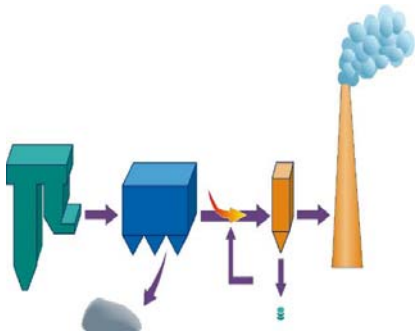
TOXECON™: Good Performance Observed at Presque Isle

TOXECON™ -- injection between ESP and baghouse

- ✓ >90% removals (PRB)
- ➢ Very limited experience on E. Bit (only low-S)
- ✓ Much less sorbent than injection ahead of ESP
- ✓ No ash impacts
- ✓ Minimizes particulate emissions
- • Operating surprises being addressed
- ➢ Requires baghouse retrofit @ $80 to >$150/kW



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Focus of EPRI Research
(w/DOE, EPA, Members, Contractor/Supplier Partners)

- **Address issues**
  - **SO_3, temperature variations, coal variations, hopper fires and evacuation**
  - **Cost-acceptable options for 90% compliance**
  - **PM emission increases (NSR?) – quantify, understand, mitigate**
  - **Confidence in technology – expand experience base to increase**
- **Improve process, reduce impacts, lower costs**
  - **Upper sorbent limit for ash use in concrete**
  - **Novel sorbents – for high T or high SO_3; with low ash impact or easily separable from ash**
  - **Novel technologies**

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User Challenges for Commercial, Compliant Application

- **Limits set at level of best performers**
  - **Data show range of performance**
  - **Reasons for site-to-site differences often not understood or predictable**
- **Are guarantees comparable to other APCDs?**
  - **If site-specific, not consistent with uniform limit**
  - **Are they comprehensive?**
    - **If ACI, more than ΔHg vs ACI rate?**
    - **If co-benefits, at what SV, ΔNOx, L/G, ΔP, etc.**
- **High ΔHg requirements ➔very low Hg emissions. Can we measure accurately?**
- **Mercury compliance measurement still WIP**
- **The unexpected?**

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Questions?

Remaining Challenges for Power Plants

- **Lack of long-term balance of plant impact studies**
  - Slagging, corrosion, air heater pluggage
  - Impact on baghouse, ESP, scrubber operation and emissions
  - Halogen and trace metal accumulation in scrubbers and flyash
  - Handling of fly ash and scrubber waste streams, potential for recycle-reuse of fly ash and sorbents, recovering and fixing mercury
- **Small increases in stack PM can trigger NSR**
  - <0.003 lb/MBtu PM emissions (0.03 lb/MBtu NSPS standard)
  - Baseline PM emissions with no carbon injection have variations > potential increases with carbon injection

Glossary

ACI	Activated Carbon Injection
APCD	Air Pollution Control Device
BCA	Boiler Chemical Additive to promote mercury oxidation
CTC	Chemically-treated (activated) carbon [e.g., bromine impregnated]
DOE-NETL	U.S. Department of Energy – National Energy Technology Laboratory
ESP	Electrostatic Precipitator for particulate (fly ash) control
FF	Fabric filter (*aka* baghouse) for particulate control
FGD	Flue gas desulfurization (*aka* scrubber) for SO_2 control
Hg	Mercury (Hg^0 = elemental or metallic Hg; Hg^{2+} is oxidized Hg)
NSR	New Source Review – requires added controls on any pollutants that increase due to control for target pollutant
PM	Particulate Matter (*aka* fly ash)
ppb	Parts per billion (1 molecule Hg among 1 billion molecules flue gas)
SCR	Selective Catalytic Reduction for NOx control